# Location-specific material characterization of LPBF SS316L & IN718 TCR core structural materials

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**ABSTRACT:**

Additive manufacturing techniques offer promising methods especially with their rapid turnaround time, potential for part consolidation, and manufacturing complex parts to deploy as TCR core structural materials. However, for AM components to present a viable replacement for conventionally manufactured counterparts, they should exhibit reliable and repeatable mechanical properties especially at elevated operating temperatures.

Due to their unique manufacturing processes that require melting metal in a layer-by-layer fashion, laser powder bed fusion (LPBF) components undergo high solidification rates and heat cycling. All of these result in variability in the underlying microstructure from one build to the next or even within the same build. With the variability of the microstructure, the resulting material properties are also expected to vary within the same build [1,2]. Therefore, there is an innate need to evaluate the spatial variability of the mechanical properties and the underlying structures of LPBF metallic components to safely use as TCR core structural materials.

Process parameters of AM machines are numerous and using an ad-hoc approach to test all the possible combinations is naïve. Therefore, the use of data-driven approaches is required to relate the process-structure-property (p-s-p) relationships in AM metals [3]. The input training data provides an opportunity to the model to extrapolate the experimental data by identifying correlations between the inputs and outputs.

*In this proposed work, we will experimentally characterize the spatial variability of the quasi-static (tensile), creep (tension and impression), and creep-fatigue properties for LPBF SS316L and IN718 components for an application as TCR core structural materials as training data to the TCR machine learning model as detailed in their September 2020 report. The underlying structures (microstructure and defect structures) of areas of interest will be evaluated to relate back to the material's meltpool signature in order to reveal the material's p-s-p relationships and provide a design path for TCR core structural materials.*